Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1.9
F76Am
Cop. 2

LIBRARY
CURRENT SERIAL RECORD
★ JUN 16 1960 ★
U. S. DEPARTMENT OF AGRICULTURE

Douglas-Fir

(*Pseudotsuga menziesii*)

By H. S. Betts, *formerly senior engineer, Division ~~of Forest Products~~*[1]

The enormous stands of Douglas-fir, the large size and splendid form of the tree, and the suitability of the wood for a wide range of building and general construction purposes make this species one of our most important sources of timber. Douglas-fir grows in the western part of the United States and Canada and also in the mountains of northern and central Mexico. Under favorable conditions, exceptional trees sometimes reach an age of 1,000 years, a height of 300 feet, and a diameter of 10 feet or more. The stand of Douglas-fir sawtimber in the United States is greater than that of any other native species. Over three-fifths of this stand is located in western Washington and western Oregon.

Lumbering operations in the Douglas-fir region are conducted on a large scale. Through improved methods of logging and milling and new processes of converting wood into such useful products as paper, fiberboard, and plastics, greater use is made of large quantities of wood formerly wasted.

Nomenclature.—Douglas-fir is the name adopted by various trade and technical associations and by the U.S. Forest Service. Other names used are red fir, Douglas-spruce, Oregon-pine, and common Douglas-fir. Another scientific name is *Pseudotsuga taxifolia.*

Distribution and growth.—Douglas-fir grows in most of the forests from the Rocky Mountains to the Pacific coast and from Mexico to central British Columbia (fig. 1). This species reaches its largest size and attains its fastest rate of growth in Washington, Oregon, and British Columbia in the region between the coast and the Cascade Mountains. Here trees up to 6 feet or more in diameter and over 200 feet high, growing sometimes in mixture with western hemlock, cedars, and other species, form very dense forests that commonly yield from 35,000 to 60,000 board feet per acre and sometimes as much as 100,000.

In the eastern part of its range in the Rocky Mountains, Douglas-fir generally grows at elevations between 4,000 and 11,000 feet and is considerably smaller in size than the coast types—generally not over 1½ feet in diameter and 90 feet high.

---

[1] Revised by Division of Forest Products Research, Forest Service, Washington, D.C., and Forest Products Laboratory, Forest Service, Madison, Wis. Mr. Betts retired in January 1945.

Production data are derived from the 1954 census of manufactures or from later estimates. Figures in table 1 are from special detailed surveys covering the use of individual species in the manufacture of wood products; the latest survey was taken for 1948.

Forest Service

U.S. DEPARTMENT OF AGRICULTURE

American Woods — Revised May 1960

540526°—60

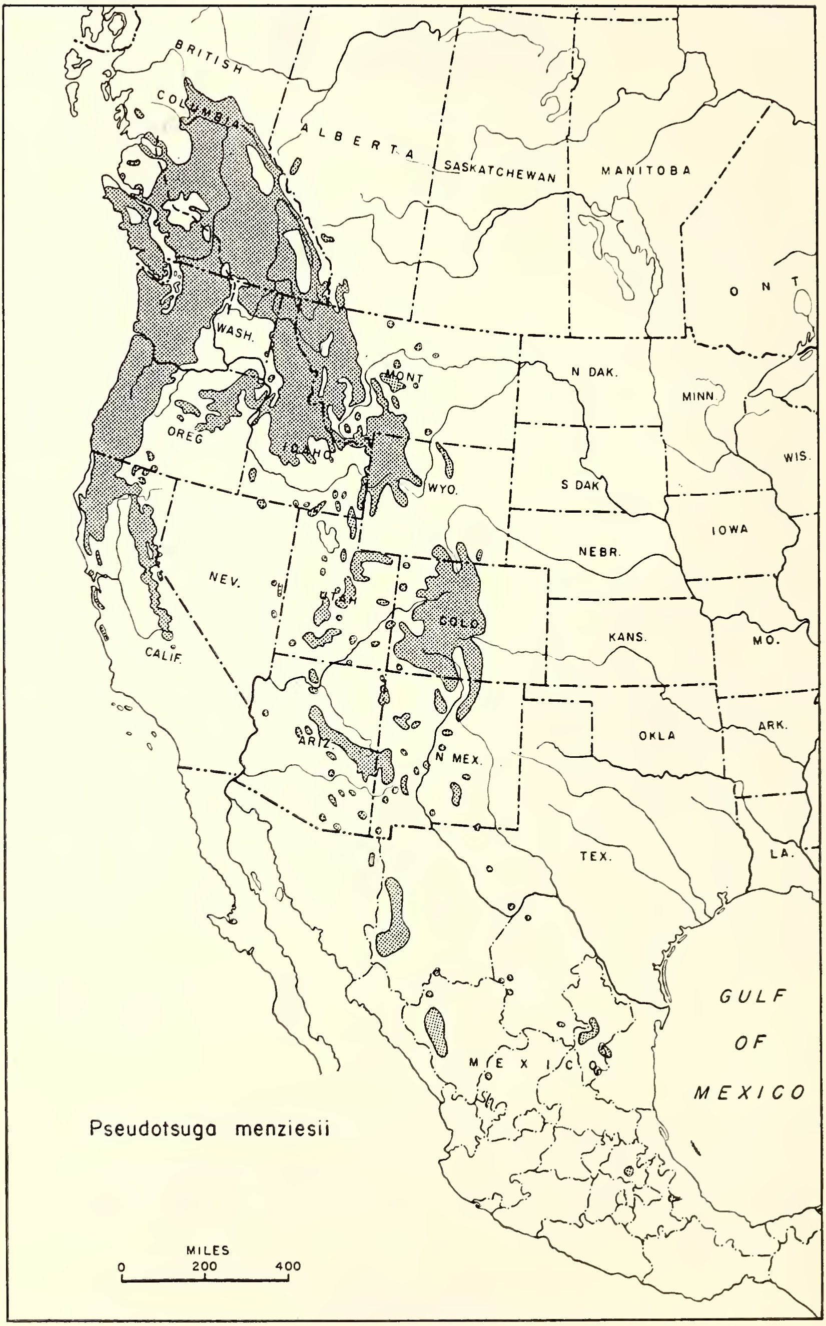

Figure 1.—Range of Douglas-fir (*Pseudotsuga menziesii*).

Douglas-fir is a vigorous, hardy tree that thrives under a wide range of soil and climatic conditions. It grows most rapidly in fairly deep, moist but well-drained soils in locations where there is at least 40 inches of rainfall a year and where the growing season is long. Douglas-fir is moderately tolerant of shade when young, but with advancing age it becomes especially dependent on overhead light. Trees overshadowed by their neighbors quickly die. Douglas-fir has exceptional ability to form dense stands. In even-aged forests 20 years old, there are normally about 900 trees to the acre, some over 30 feet in height. As the forest ages and competition for light becomes more intense, the weaker trees die. In a normal forest 100 years old, there are about 115 trees to the acre—a large proportion close to 2 feet in diameter. By this time, the larger trees approach 200 feet in height and have nearly attained full height growth. Diameter growth continues much longer.

A good seed producer, Douglas-fir bears heavy crops of cones at intervals of 2 to 4 years. The tree reproduces by seed only and not by sprouting. The seed is light and winged and is scattered widely by the wind. Douglas-fir seed germinates readily anywhere it happens to fall, provided there is sufficient moisture. If the seedlings are to survive, however, they must have light and their roots must reach mineral soil quickly.

Douglas-fir forests suffer comparatively little from attacks by fungi or insects. The only serious attacks by decay-producing fungi occur in young seedlings and in overmature trees. The most destructive insects are those that devour the needles or destroy the inner bark. The depredations of these pests in certain areas have resulted in the loss of millions of feet of high-quality timber.

Supply.—The total stand of Douglas-fir of sawtimber size in the United States amounted to 532 billion board feet in 1953, or 27 percent of the total volume of sawtimber of all species. The stand was restricted to certain western States and distributed as follows:

Area:	*Million board feet*
Western Washington	91,911
Western Oregon	245,340
Eastern Washington	17,763
Eastern Oregon	10,898
Idaho	26,586
Montana	15,329
California	116,912
Southern Rocky Mountain	7,129
Total	531,868

Western Washington and western Oregon together thus contained slightly more than 63 percent of the total Douglas-fir stand. In this region, despite the heavy cutting that has taken place, over 60 percent of the stand is still in old-growth trees more than 31 inches in diameter. These trees furnish a large proportion of the narrow-ring, slow-growing Douglas-fir suitable for the manufacture of high-quality lumber and veneer. The softwood plywood and veneer industry, for example, is dependent almost entirely upon Douglas-fir as a source of raw material.

Production.—The production of Douglas-fir lumber amounted to 10.3 billion board feet in 1954 and accounted for 28 percent of all lumber produced in the United States (fig. 2). The average annual

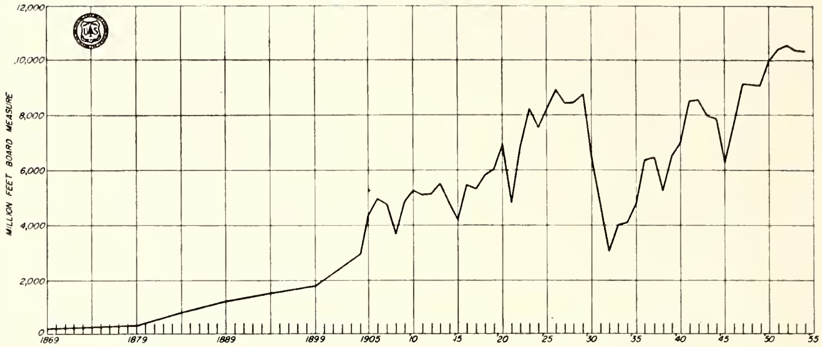

Figure 2.—Lumber production of Douglas-fir, 1869–1954.

production of the 10-year period 1945–54 was approximately 9.3 billion board feet. During this period, Oregon accounted for 58 percent of the cut, Washington 25 percent, California 12.6 percent, and the other States listed above for the remaining 4.4 percent.

Among the 10 individual species listed in the lumber production statistics for 1869, Douglas-fir ranked ninth with a cut of about 196 million board feet. By 1906, production of Douglas-fir had become second in importance with a cut of approximately 5 billion board feet; since then, it has held or improved that position in most years. In the production of lumber in 1954, Douglas-fir was first, with a cut 41 percent greater than its nearest competitor, southern pine. In the early years for which data are available, over half of all the Douglas-fir lumber was produced in Washington, approximately one-third in Oregon, and the remainder in the 10 other States within the Douglas-fir range.

The volume of Douglas-fir logs consumed in the manufacture of veneer and plywood increased slowly between 1890 and the late 1930's. After 1937, however, production climbed more rapidly, rising from about 460 million board feet in that year to the 1955 level of 2.3 billion board feet. Douglas-fir has supplied between 95 and 98 percent of the wood consumed in the softwood veneer and plywood industry in Oregon, Washington, and California. The rapid increase in the consumption of Douglas-fir veneer logs in recent years can be attributed to expanding uses for softwood plywood. Substitution of softwood plywood for lumber, particularly in sheathing and subflooring, has advanced rapidly. Part of the increase in the use of softwood plywood, however, must be attributed to the development of moisture-resistant and waterproof glues that permit the manufacture of exterior grades of plywood for use in exposed locations without risk of glue failure.

In addition to the Douglas-fir cut for lumber and veneer, a substantial volume is cut for poles, piling, pulpwood, cooperage, fuelwood, fence posts, and a miscellaneous assortment of other timber products. Statistics on the production or consumption of these products are not available except for those that are given a preservative treatment before being placed in service. In 1956, about 438,000 poles, 4.8 million linear feet of piling, and 16,000 posts received preservative treatment. The average annual cut of Douglas-fir for all purposes in recent years is estimated to range between 12 and 14 billion board feet annually.

Properties.—The wood of Douglas-fir varies widely in quality both in the Pacific coast type, which makes up all but a small portion of the cut, and to a lesser extent in the Rocky Mountain type. Average material from the Pacific coast is rated as strong, moderately hard, moderately heavy,[2] and very stiff. In strength, Pacific coast Douglas-fir ranks approximately with the whole southern pine group. Douglas-fir from the Rocky Mountains averages below that from the Pacific coast in weight and in strength properties.

Douglas-fir has a narrow whitish sapwood generally not over 3 inches wide in timber of commercial size and often not over 1 inch wide in Rocky Mountain timber. In comparatively young trees of the coast type, the rate of growth is generally quite rapid; the wood of such trees frequently shows from three to six rings to the inch. The wood formed when the trees are older is generally of slower growth, having from 15 to 30 rings to the inch. Tests on small clear pieces of Douglas-fir show that the strongest and heaviest wood frequently has from 12 to 24 rings per inch. Dry weight, however, where it can be determined, is a better criterion of strength than rate of growth. The wood splits easily and is rather difficult to work with handtools. It can be readily kiln dried if proper methods are used, but care must be taken in drying lumber containing knots to prevent them from becoming loose or falling out.

Dense Douglas-fir is of intermediate durability, ranking with dense southern pine and white oak in decay resistance but below the cedars, cypress, and redwood. The wood is difficult to impregnate with a preservative. Material to be treated is often incised; that is, run between cylinders having sharp projections that cut ½-inch slots to allow better penetration of the preservative.

In ability to hold paint satisfactorily, Douglas-fir ranks low. It is classed in the least satisfactory of four groups of wood arranged in the order of paint-holding ability. High tearing strength is an outstanding characteristic of kraft pulp made from Douglas-fir. This pulp is valuable to the pulp and paper industry because it is mixed with pulps from other species of wood for many uses. While not among the easiest woods to glue, Douglas-fir can be glued satisfactorily if moderate care is exercised.

Principal uses.—Douglas-fir is used principally for building and construction in the form of lumber, timbers, piling, and plywood. Considerable quantities also go into fuel, railroad ties (largely sawed), cooperage stock (principally tight staves for casks, half barrels, and kegs used as containers for such products as pork and oil), mine timbers, and fencing. The lumber used in the manufacture of various products goes principally into sash, doors, and general millwork; boxes and crates; car construction and repair; and flooring. Smaller amounts are used for furniture, ships and boats, fixtures, motor vehicle parts, wood pipe, tanks, and other miscellaneous items. Minor uses include distillation products and paper pulp.

The strength and stiffness of Douglas-fir, combined with its moderate weight and availability in large sizes, gives it a leading place

---

[2] The average weight of Douglas-fir in a thoroughly air-dry condition (12 percent moisture) is 34 pounds per cubic foot for material from the Pacific coast and 30 pounds per cubic foot for material from the Rocky Mountains.

Table 1.—*Douglas-fir used in the manufacture of wood products, by specified years, 1912–48*

Product	1912	1928	1933	1940	1948
	M bd. ft.	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*
Airplanes	----	12	19	945	1, 874
Agricultural implements	2, 537	9, 565	1, 108	2, 877	10, 354
Boot and shoe findings	----	25	----	----	464
Boxes, cigar and tobacco	----	57	----	----	----
Butchers' blocks	----	----	90	----	----
Car construction and repair	86, 544	371, 503	88, 748	203, 099	148, 166
Caskets and burial boxes	6	500	80	207	4, 830
Conduits, pumps, woodpipe	[1] 24, 851	[1] 6, 751	1, 542	14, 400	588
Containers (except cooperage)	[2] 7, 350	[2] 75, 301	38, 878	130, 033	166, 331
Crossarms	(3)	(3)	(3)	(3)	16, 807
Dairy, poultry, other supplies	(4)	1, 543	103	180	534
Dowels, skewers, and wedges	----	[5] 17	[5] 75	26	34
Electrical equipment	138	614	1, 947	2, 145	38, 769
Fixtures	5, 512	4, 968	4, 418	23, 263	67, 257
Flasks	[6] 54	[6] 180	[7] 200	[7] 3, 267	2, 083
Flooring	(8)	(8)	128, 658	80, 197	127, 742
Furniture	11, 453	11, 677	24, 049	44, 689	68, 639
Grain doors	(9)	(9)	(9)	(9)	30, 849
Handles	247	9, 485	11, 311	12, 299	20, 765
Housetrailers	(10)	(10)	(10)	(10)	18, 840
Instruments, musical	480	685	61	53	672
Instruments, professional and scientific	30	227	45	58	1, 158
Ladders	(4)	(4)	2, 020	8, 212	17, 036
Laminated structural members	(3)	(3)	(3)	(3)	23, 122
Laundry appliances	184	1, 836	261	417	2, 562
Machinery	1, 631	310	207	329	1, 075
Millwork	[11] 1, 991, 992	[11] 1, 896, 648	148, 293	391, 222	395, 138
Pallets	(12)	(12)	(12)	(12)	19, 404
Patterns	(6)	(6)	(7)	(7)	1, 803
Plumbers' woodwork	----	----	----	----	1, 000
Prefabricated houses and house panels	(3)	(3)	(3)	(3)	73, 997
Prefabricated structures except houses	(3)	(3)	(3)	(3)	6, 891
Printing material	----	150	----	22	58

Radios, phonographs, sewing machines	(13)	(13)	1, 384	3, 252	9, 039
Refrigerators	[14] 544	[14] 10, 887	2, 393	9, 437	14, 069
Rollers, shade and map	3, 000	93	12	2	1, 466
Ship and boat building	44, 342	33, 705	10, 040	25, 333	30, 226
Shuttles, spools, and bobbins				80	83
Signs, scenery, displays	36	13, 410	1, 104	5, 254	12, 622
Sporting equipment, athletic and playground	86	1, 854	93	7, 735	7, 804
Surgical supplies				1	68
Tanks	89, 705	42, 513	4, 142	12, 590	4, 679
Toys		760	64	431	1, 272
Trunks and valises		2, 407	1, 033	1, 091	5, 894
Vehicles, motor	(15)	36, 345	12, 467	15, 490	21, 959
Vehicles, nonmotor	931	631	64	2, 067	7, 760
Venetian blinds				119	13, 085
Woodenware, novelties, and miscellaneous	2, 135	12, 770	560	2, 669	5, 743
Total	2, 273, 788	2, 547, 429	485, 469	1, 003, 491	1, 404, 611

---

[1] Includes paving material.

[2] Does not include Douglas-fir used for containers by plants not classified as manufacturers of wood products, which were included in later surveys.

[3] Included in "Millwork."

[4] Included in "Woodenware and novelties."

[5] Does not include skewers.

[6] Does not include Douglas-fir used for flasks and patterns by plants not classified as manufacturers of wood products and included in later surveys.

[7] "Flasks" and "Patterns" combined.

[8] Included in "Millwork."

[9] Included in "Car construction and repair."

[10] Included in "Vehicles, nonmotor."

[11] Includes planing mill products, such as flooring, siding, ceiling.

[12] Included in "Containers."

[13] Radio and phonograph cabinets included in "Furniture."

[14] Includes kitchen cabinets.

[15] Included in "Vehicles, nonmotor."

as a structural timber. Pieces can be supplied as large as 2 feet square in cross section and 60 feet long. Glued laminated timber of large dimensions is now used extensively for beams and arches. Douglas-fir plywood [3] has come into wide use for sheathing, concrete forms, wallboard, prefabricated house panels, and other structural forms. Construction timbers exposed to conditions favorable to decay or insect attack, including bridge timbers, piling, ties, mine timbers, and timbers for marine construction, are generally pressure treated with creosote and other standard preservatives.

Attempts to distill Douglas-fir to obtain turpentine, pyroligneous acid, tar oil, and charcoal have been limited to a few plants using pitchy wood selected from sawmill waste. Douglas-fir, largely in the form of sawmill waste, is used in the manufacture of fiberboard, book paper, and wrapping paper.

Most of the total cut of Douglas-fir lumber, possibly two-thirds of it, is used as it comes from the sawmill. The remainder is manufactured further before use. Table 1 shows the amounts of Douglas-fir used in the manufacture of different classes of products in specified years. The material is largely in the form of lumber, with much smaller amounts of veneer and short logs and bolts.

REFERENCES

CHECK LIST OF NATIVE AND NATURALIZED TREES OF THE UNITED STATES (INCLUDING ALASKA). Elbert L. Little, jr. U.S. Dept. Agr. Handb. 41, 472 pp. 1953.

FOREST TREES OF THE PACIFIC SLOPE. George B. Sudworth. U.S. Dept. Agr. Unnumbered Pub., 441 pp., illus. 1908.

GROWTH AND MANAGEMENT OF DOUGLAS-FIR IN THE PACIFIC NORTHWEST. T. T. Munger. U.S. Forest Serv. Cir. 175, 27 pp., illus. 1911.

KNOTS IN SECOND-GROWTH DOUGLAS-FIR. Benson H. Paul. U.S. Forest Serv., Forest Prod. Lab. Rpt. R1690, 11 pp., illus. 1947. [Processed.]

LOGGING IN THE DOUGLAS-FIR REGION. W. H. Gibbons. U.S. Dept. Agr. Bul. 711, 256 pp., illus. 1918.

NATURAL REGENERATION OF DOUGLAS-FIR IN THE PACIFIC NORTHWEST. J. V. Hoffman. U.S. Dept. Agr. Bul. 1200, 63 pp., illus. 1924.

PROPERTIES AND USES OF DOUGLAS-FIR. M. Cline and J. B. Knapp. U.S. Forest Serv. Bul. 88, 75 pp., illus. 1911.

RELATIONSHIP OF LOCALITY AND RATE OF GROWTH TO DENSITY AND STRENGTH OF DOUGLAS-FIR. John T. Drow. U.S. Forest Serv., Forest Prod. Lab. Rpt. 2078, 56 pp., illus. 1957.

SILVICAL CHARACTERISTICS OF DOUGLAS-FIR (VAR. MENZIESII). Leo A. Isaac and Edward J. Dimock II. U.S. Forest Serv. Pacific Northwest Forest and Range Expt. Sta. Silvical Series No. 9, 18 pp., illus. 1958.

TIMBER GROWING AND LOGGING PRACTICE IN THE DOUGLAS-FIR REGION. T. T. Munger. U.S. Dept. Agr. Bul. 1493, 42 pp., illus. 1927.

TIMBER RESOURCES FOR AMERICA'S FUTURE. Forest Service. U.S. Dept. Agr. Forest Resource Rpt. 14, 713 pp., illus. 1958.

WOOD QUALITY IN RELATION TO SITE QUALITY OF SECOND-GROWTH DOUGLAS-FIR. Benson H. Paul. Jour. Forestry 48: 175–179. 1950.

---

[3] Plywood generally consists of an odd number of sheets of veneer (usually 3, 5, or 7) glued together so that the grain of each sheet or ply is at right angles to the grain of the adjacent ply or plies. The veneer is made by the rotary-cut method in which short logs are revolved in a lathe against a constantly advancing heavy knife. It is commonly cut about 1/16 inch or 1/8 inch thick. The plywood is made in stock thicknesses from about 1/4 inch (3 plies) to 1 1/8 inches. For interior construction the plies are frequently glued with soybean, blood, or extended phenolic glues. For permanent exterior construction, "resin-bonded" plywood glued with phenolic-resin glues provides a highly water-resistant bond.

U.S. Government Printing Office: 1960

For sale by the Superintendent of Documents, U.S. Government Printing Office,
Washington 25, D.C. - Price 5 cents.